

ABSTRACT

An instrument for performing highly accurate PCR employing an assembly, a heated cover and an internal computer. The assembly is made up of a sample block, a number of Peltier thermal electric devices and heat sink, clamped together. The sample block temperature is changed exclusively by the thermoelectric devices controlled by the computer. The sample block is of low thermal mass and is constructed of silver. The Peltier devices are designed to provide fast temperature excursions over a wide range. The heat sink has a perimeter trench to minimize edge losses and is adjacent to a continuously variable fan. A perimeter heater is used to improve the thermal uniformity across the sample block to approximately  $\pm 0.2^{\circ}\text{C}$ . A heated platen pushes down onto the tube caps to apply a minimum acceptable force for seating the tubes into the block, ensuring good thermal contact with the block. The force is applied about the periphery of the tube caps to prevent distortion of the caps during thermal cycling. The platen is heated to provide thermal isolation from ambient conditions and to prevent evaporation from the surface of the sample into the upper portion of the sample tube. A control algorithm manipulates the current supplied to the thermoelectric coolers such that the dynamic thermal performance of the block can be controlled so that pre-defined thermal profiles for the sample temperature can be executed. The sample temperature is calculated instead of measured using a design specific model and equations. The control software includes calibration diagnostics which permit variation in the performance of thermoelectric coolers from instrument to instrument to be compensated for such that all instruments perform identically. The block/heat sink assembly can be changed to another of the same or different design. The assembly carries the necessary information required to characterize its own performance in an on-board memory device, allowing the assembly to be interchangeable among instruments while retaining its precision operating characteristics. The instrument has a graphical user interface. The instrument monitors the thermoelectric devices and warns of changes in resistance that may result in failure.